# Some Environmental Aspects of Chemical Weed Control in Nursery Stock

**J.C. Kelly and D.W. Robinson**
Kinsealy Research Centre, Malahide Road, Dublin 17, Ireland

## INTRODUCTION

Nurserymen must achieve high standards of weed control. Herbicides have been used effectively for this purpose for decades but despite campaigning by environmentalists to eliminate their use, herbicide application is likely to continue, albeit at a reduced level. Legislation to control the amount of chemicals applied, leached, or discarded will intensify and so alternative methods of weed control, which eliminate or minimise herbicide use, are being studied. A greater understanding of the principles of chemical control and of alternative methods of weed suppression can also reduce herbicide use.

## GENERAL PRINCIPLES

Most of the literature on weed control deals with specific chemicals to control certain weeds. Less attention is given to application techniques which could ensure that the correct dose for effective weed control, consistent with both crop and environmental safety, is achieved. Errors in calibration, or faulty applicators, often result in crop damage, inadequate weed control, and wastage of herbicide through overdosing or non-target application.

An understanding of the mode of action of the main types of herbicides and of the growth habits of the species grown is critical in making correct decisions about herbicide use in nurseries. For example, there should be sufficient leaf development of perennial weeds before spraying with glyphosate; substrates should have a suitable moisture content prior to the application of a soil-acting herbicide—these can often be applied effectively shortly before the crop makes a flush of growth to form a closed canopy.

Understanding the susceptibility of weed species to different herbicides enables the correct herbicide to be selected for specific weed problems. For example, Bond (1977) showed that propyzamide is over 100 times more effective against *Polygonum arenastrum* (syn. *P. aviculare*) than against *Senecio vulgaris*. Simazine is weak on polygonums, cleavers, and atriplex and usually gives poor control of speedwells. In contrast, propyzamide gives good control of these weeds but is weak on Compositae.

Selecting the right nozzle and optimum application method for each weed control operation is essential. For example, when spot treating small patches of perennial weeds in lined-out trees with a leaf-acting herbicide, a single nozzle wetting a narrow swath will enable more of the herbicide to reach the target than would wide-angle nozzles. In some situations, herbicides can be more effectively applied by means of rope wicks or sponges; with these, all the chemical applied reaches the target weeds.

Different herbicides, with their varying toxicities, carry different degrees of environmental risk. Long-term trials suggest that glyphosate has little or no environmental risk if used in accordance with the manufacturers' instructions and

a case can be made for substituting glyphosate, where appropriate, for more environmentally hazardous chemicals. Like any other herbicide, however, the repeated use of glyphosate alone, in the absence of any other weed control measure, is likely to result in the build-up of resistant biotypes (Robinson, 1992).

**Thermal Techniques.** The development of new machinery, including flame guns and microwaves during the 1980s, increased the interest in the possibility of high temperatures at the soil surface to control weeds. Modern flame guns, using liquified petroleum gas, are being used by some local authorities on hard surfaces to suppress weeds either by direct heat or by infrared radiation.

Good results have been obtained in Denmark with "flame cultivation" on bare ground, but the selective use of high temperatures among growing plants is very difficult (Vester, 1988). The results of this work showed the importance of a level soil surface and vigorous crop growth at the time of treatment. In general, flame control is more expensive than chemical or cultural control and so its use is likely to be restricted to situations where cultivation (e.g., on hard surfaces) or herbicides cannot be used.

**Biological Control.** The prospects for biological control of weeds in nursery stock using insects, nematodes, and pathogens are not encouraging. Although striking successes against weeds have been achieved in a number of countries, the weeds have tended to be introduced species, such as *Opuntia* spp. controlled in Australia using the Argentinian moth, *Cactoblastis cactorum*. In this type of control the introduced agent is self-sustaining once established. Despite research programmes in many countries, developments have been slow, largely because of the risk that an introduced agent may damage desirable plants. In any case, control of one or two weed species only would be of limited value in nurseries which are normally affected by a dozen or more species.

**Endemic Mycoherbicides**. A mycoherbicide contains the spores of a naturally occurring pathogen, specific to a particular weed species, but which is not normally present in the environment in sufficient quantity to kill the weed. When bulked up and applied in high concentration at a vulnerable growth stage of the weed, mycoherbicides can be effective. Some mycoherbicides, e.g., Devine (*Phytophthora palmivora*) and "Collego" (*Colletotrichum gloeosporiodes* Penz. f. sp. *aeschynomenae*), have been registered in the U.S.A. (Cullen and Hassan, 1988). Work is also in progress with mycoherbicides for the control of some of the most common weeds of northwestern Europe, including *Senecio vulgaris*, *Stellaria media*, and *Chenopodium album* (Sunderland, 1990). Further research is likely to produce other fungi that could be developed as mycoherbicides but which are ineffective in nature because of poor overwintering. Although some progress along these lines is expected, there is no practical application for mycoherbicides in nurseries at present, and the possibilities for the future in this area are not bright in the short to medium term.

**Mulches**. Weeds can be successfully controlled by mulches of plastic film or organic material. Provided a 75-mm layer of bark mulch is properly applied, 95% weed control should be achieved over a 3-year period (Campbell-Lloyd, 1986). Apart from the smothering effect of mulches, chemicals in the materials used can also affect weeds. In general, however, mulches are more suitable in long-term amenity plantings than in nurseries.

Perennial weeds can emerge through deep layers of organic mulch and, if present when the mulch is applied, are likely to thrive because of the absence of competition from annuals. Opaque plastic materials give excellent control of annual weeds and are more effective than organic mulches against perennials. However, some of the more aggressive perennial species, or those with sharply pointed shoots such as couch grass (*Elymus repens*) can penetrate thin polythene (38 micron) film (Davison, 1983).

Despite the general efficacy of mulches against weeds, problems can arise with both opaque synthetic and organic mulches. If plastic mulches are torn, accidentally or to assist water penetration, weed growth through the holes will be vigorous (Rowe-Dutton, 1976). Even with undamaged plastic vigorous weed growth can occur at the gap around the stem or stake.

Although mulching is generally regarded as a good horticultural practice, undesirable side effects can also occur, so mulches must be used with care. The value of mulching, like many other horticultural practices, depends very much on local circumstances, such as soil, climate, and the type and growth stage of the plants to be mulched. Organic mulching material is bulky and costly to transport. Consequently traditional organic mulches are likely to be of more use in prestige amenity plantings than in nurseries where high costs are likely to limit their use.

Recently, discs of geotextiles, paper, fibreglass, and black polyethylene placed on top of the substrate after potting have been used for weed control in containerised stock. In a comparison with the herbicides oxyfluorfen plus pendimethalin, oxydiazon, and oryzalin plus benefin, best weed control was obtained with a combination of a geotextile disc plus preemergent herbicide (trifluralin) (Appleton and Derr, 1990 ). The other disc covers did not result in good weed control due, in some cases, to poor fitting in relation to pot size.

Mulches can often be used in association with soil-acting herbicides to achieve superior weed control, but in experiments at Kinsealy, using a bark mulch on *Picea excelsa*, best results were achieved when the herbicide was applied before the mulch.

## SOILS

The herbicidal effect of many soil-acting compounds, such as simazine, is influenced by the physical characteristics of the growing medium, especially clay and organic matter content. A good knowledge of the soil or container substrate and its adsorptive capacity helps the judicious use of herbicides and the selection of the optimum herbicide dose for a specific weed population.

## CONCLUSIONS

It is clear from experiments at Kinsealy and elsewhere that the solution to the weed problem does not lie in any one method of control. Reliance on the repeated use of one herbicide only will result in time in the build-up of resistant biotypes. Organic mulches are generally too expensive for use in nurseries. Here, the future of weed control lies in an integrated management approach where physical and other methods can be used, with the judicious application of chemicals, to reduce herbicide use.

## LITERATURE CITED

**Appleton, B.L.** and **J.F. Derr**. 1990. Use of geotextile disks for container weed control. HortScience 25:666-668.

**Bond, W**. 1977. Species response to prodiamine. National Vegetable Research Station Annual Report, 117.

**Campbell-Lloyd, R**. 1986. Mulching—doing it right. Landscape Design 163:75.

**Cullen, J.M**. and **S. Hasan**. (1988). Pathogens for the control of weeds. Philosophical Transactions of the Royal Society of London B 318:213-224.

**Davison, J.G.** 1983. Weed control in newly planted amenity trees. Proc. Symp. on Tree Establishment. Univ. of Bath, 14-15 July 1983. p. 59-67

**Robinson, D.W.** 1992. Glyphosate concern. Horticulture Week 212, 21:16 -17.

**Rowe-Dutton, P.** 1976. Mulching is important. The Garden. J. Royal Hort. Soc. 101:135-139.

**Sunderland, K.D**. 1990. The future for biological control. Professional Horticulture 4(1):11-20.

**Vester, J.** 1988. Flame cultivation for weed control. Weed control in vegetable production. Proc. of a meeting of the EC Experts' Group/Stuttgart, 1986:153-167